MARSHALL COUNTY.

W. H. THOMPSON.

Marshall County is one of the most interesting of all the counties of Indiana, especially as regards its topography, its surface geology, and its agricultural importance. It is extremely well situated with regard to all the facilities for production and shipment, having excellent and varied soil, good public roads, superior drainage, and railroads running to almost every point of the compass.

Marshall County is bounded on the north by St. Joseph County, east by Elkhart and Kosciusko counties, west by Starke and St. Joseph counties, and south by Fulton and Kosciusko counties. It is about twenty one miles square, and was named in honor of Chief Justice Marshall.

In order that the reader may fix in his mind the relative geographical position of this county, let it be remembered that it lies a little more than forty miles south-east from Lake Michigan, and holds in its extreme south-western corner that loveliest of lakelets, the far-famed Maxinkuckee.

The county was first permanently settled by the whites in the spring of the year 1832; but it was not until the year 1835 that a great movement began by a public sale of the lands at the land office in Laporte, from which time to the present there has been a remarkable growth in wealth and population, and a corresponding increase of energy, education and culture.

No county in Indiana, all the circumstances considered, has excelled Marshall in matter of educational progress. Her public schools are of the best, and her citizens have taken the highest pride in advancing every literary and scientific impulse or enterprise brought to their attention. As might be expected of such a population, business in all its branches has flourished in this county from the start, and Plymouth, the beautiful county seat, has long been one of the most enterprising and wealthy little cities of Northern Indiana—a center of culture and social refinements, charming to all who come within its influence. Plymouth was made the county seat in 1836, and the organization of the county into townships, for civil purposes, was begun in the spring of the same year.

In the early part of its history, Marshall County, in common with most of Indiana, was troubled with malaria, but an excellent system of drainage, the cultivation of soil and cleaning of the forests, have obviated this

difficulty so that now it is a remarkably healthful part of our commonwealth; indeed, its beautiful, clear lakes have become summer resorts for invalids and those seeking recreation and refreshment.

Plymouth is situated very near the center of the county, on both banks of Yellow River (a beautiful stream which flows across the county from north-east to south-west) and is a city peculiarly attractive to the visitor on account of its well-kept streets, its handsome public buildings, and its many picturesque and home-like residences. From all points the views are lovely, embracing bright glimpses of fertile country and shaded city lawns, with the river shining between.

The natural drainage of Marshall County is excellent, and it has been supplemented by a great deal of intelligent labor in the direction of systematic ditching. Lands which were noted formerly for their impassable bogs are now under a high order of cultivation, and are extremely fertile. I have seen no finer farm lands in Indiana than a large part of this county, which was once far too wet for the plow.

As has been said already, Yellow River is the principal stream, flowing midway through the county with a brisk current, and a clear, bright volume, receiving, during its course, a great number of tributaries, large and small, the majority of them east or north-east of Plymouth.

The Tippecanoe River flows in a short "elbow" across the extreme south-eastern corner of the county, receiving Deep Creek as its principal tributary, a stream flowing south-east across Walnut Township, and a part of Tippecanoe.

Forge Creek, rising among some small lakes three miles south-west of Plymouth, runs into Starke County, as does Pine Creek, in the extreme north-western corner of the county.

These streams afford the basis of ample drainage, while at the same time they furnish water power of a high value. Extensive ditches have been constructed in various parts of the county, and farmers have exhibited great enterprise and intelligence in the use of underground tiles, but the work of artificial drainage is yet in its incipiency as compared with possible results, or even with what will probably be accomplished before many years have passed.

Parts of Marshall County, even now, after years of most destructive abuse of economy, are well and heavily timbered with hard woods. Sawmills have been doing a thriving business, however, and, as is the case over most of our State's area, the glory of the forests is in the past. Much of the county is prairie, and there are large tracts of what is called "barren land;" but this phrase does not signify a thin soil, for the "barrens" often are choice land for tilling and grazing purposes. Indeed, with the exception of that covered by the many small lakes, there is scarcely any waste land in Marshall County, though much of it needs further ditching to make it properly tillable.

GEOLOGY.

The entire area of Marshall County is covered, to a great depth, with the deposits of the Drift period. No stratified rocks are outcropping, nor have they been reached by any of the many borings. The surface is, for the most part, a dark or black sandy loam, varying from a muck to a very light, warm soil. Underlying this are gravels, sands and bowlder clays.

The beds of the streams are usually in the gray or bluish till common to our glacial deposits, and are covered with a stratum of washed gravel, sand and bowlders. The terraces of the Yellow River are very interesting in this county and Starke, especially those composed of a fine yellowish sand which appears to be identical with that of Lake Michigan. This sand is most prevalent in the south-western part of Marshall County, while it runs in great waves and ridges entirely across Starke to the bank of the Kankakee.

Between the Yellow River and the Tippecanoe there is a low divide in the form of a heavy swell of the Drift deposits. From near the southern line of Bourbon Township the drainage is into the Yellow, while from that line southward it goes into the Tippecanoe. Again, in the townships of North and Polk, Pine Creek and Yellowbank River flow north-westward, while in the southern part of Polk Township the drainage is southward into the Yellow River. The above conditions are due to the undulations in the grand mass of the Drift probably caused by recessions of the glacier, or whatever power was urging southward this vast silicious conglomeration known as bowlder till. Nowhere in Indiana is this slow and, as it were, jerking process of recession better exemplified. The valley of the Yellow River is simply a great furrow between well-defined waves of this glacial mass in which the immediate bed of the stream is cut, and from side to side of which it has shifted through the long series of years since the melting of the ice. Whenever the fine sand of which I have spoken prevails, it rests, as a rule, immediately upon the blue or gray bowlder till, no soil or sedimentary deposit intervening. I gave careful attention to all the features of the Drift in this county, and have submitted my observations in the form of a classified statement of facts to the Chief of the Department to be used in his studies of the glacial deposits of Indiana. It may be well to remark just here that very little red clay, saving certain ferruginous deposits, is found in this county.

In many parts of the county the surface of the ground is thickly strewn with bowlders of various kinds, chiefly granite, gneiss and other metamorphic rocks, fragmentary, and often worn into symmetrical shapes, or fancifully truncated and grooved, cumbering the fertile fields with their indestructible bulks. Upon these interesting but unprofitable relics of glacial power the farmers have waged relentless war, bursting them with

fire and with dynamite, and hauling them into heaps, or using them for building rough stone fences. This superficial deposit of bowlders appears to be the result of some agency acting subsequent to the force which urged the great mass of glacial matter down upon Indiana. No doubt this post-glacial, or rather this secondary agency, was dual, being a combination of water currents and floating ice-bergs; for water currents, unaided by the transporting agency of floating ice, could not move bowlders weighing many tons each, without also washing away, at the same time, the whole drift deposit down to the stratified rocks. Action of water alone, if of sufficient power to drive along before it these immense fragments, would be equaled by nothing short of a sea under the influence of a long-continued hurricane blowing steadily in one direction.

The wells and borings in Indiana, and especially in the northern half of the State, support the assumption that bowlders are much more numerous upon the surface of the Drift than throughout its mass. I have seen wells dug forty feet through Drift clay without encountering a bowlder in a region were the surface was literally cumbered with immense ones. My studies, soundings and surveys of the lakes of the county are to be incorporated in a separate paper under an appropriate head, but it is well to say here that all the ponds and lakes that I have examined in Northern Indiana are mere basins, more or less symmetrical, scooped in the clays of the Drift. Many of them have huge bowlders scattered over their bottoms, and some of them have rims of whitish lime marl. This lime marl is reported upon in another paper in detail, and it is sufficient to remark that very considerable deposits of it are found in Marshall County in the beds of old ponds, or in marshy tracts favorable to its precipitation from the water bearing it in solution. To soils poor in lime this marl would prove an excellent fertilizer. When burned it makes a crude lime suitable for domestic purposes, but not of marketable quality. No doubt the time will come when these deposits will be utilized for the manufacture of the commercial fertilizers so much used in Southern States.

IRON ORES.

The only iron-ore I observed in Marshall County is a rather inferior bog ore. Many years ago in West Township, at the lower end of Twin Lakes, an iron furnace was erected, and the ore found near there was mined and manufactured, but of course the experiment failed after a time, and the old forge is no more to be seen. Indeed, scarcely a vestige of it remains.

CLAYS.

Good brick and ditch-tile clays are plentiful wherever the grayish Drift deposits are near the surface.

THE LAKES.

By far the most interesting geological features of Marshall County are its lake basins. The consideration of these will appear in detail in another paper. What is given here must be merely a description of the most important ones from a topographical point of view. Lake of the Woods, or Wood Lake, Pretty Lake, Twin Lake, and Maxinkuckee may be taken as the four most interesting.

Wood Lake is about one and three-fourths miles long by an average of a half mile in width, and is situated on the dividing line between German and North townships, about six miles north-east of Plymouth, and some four miles south-west of Bremen.

Pretty Lake is nearly three miles south-west of Plymouth, and is all its name implies—a beautiful, silvery clear lakelet and a great resort for pleasure parties.

Twin Lakes, two lovely sheets of water south by south-west from Plymouth about three miles, are also much resorted to in summer.

Maxinkuckee, a lake three miles long by nearly two miles wide, in places, lies in nearly the extreme south-western corner of the county, distant from Plymouth about nine miles. Nowhere in the United States is there a lovlier body of pure cold water. It has become a famous summer resort, and deserves all the great praise it has received. In their main topographical features all these lakes are alike, being set in bowls sunk in almost impervious bowlder clay and partly surrounded by more or less abrupt shore lines. They are well stocked with pan-fish of various kinds, but the bass are becoming scarce.

SPRINGS, BORINGS AND FLOWING WELLS.

The mineral springs and flowing wells of Marshall County must be studied in connection with the rivers and lakes, especially the latter. Impervious blue clay always overlies the mass of gravel or sand out of which these springs rise and these wells flow. This same impervious clay underlies the water of the lakes. It will not follow from this, however, that the water of the lakes will rise as high as that of the flowing wells, for the lakes are controlled by their possible or actual outlets, or they may be supplied from a different reservoir. But it is true, nevertheless, that all the deep, clear lakes of this county are fed chiefly from springs rising out of the bottom clay or flowing from the strata of sand in the sides of the basin. The water of the flowing wells comes from the same or similar sources, that is, it rises from beneath an impervious stratum of bowlder clay. These wells have been successfully operated in many parts of the county, but the most notable example is the famous one at Plymouth, which sends up a constant stream of water thirteen inches in diameter to the hight of

fifteen feet above low water mark of Yellow River. At most places in the county wells, when properly tubed, will either flow above the surface of the ground or the water will rise to within a few feet of the top of the bore.

It is difficult to over-estimate the value to farmers, manufacturers and to a community in general, of flowing wells that are as easily made as those of Marshall County. How infinitely superior to a hand-pump or a wind-pump is a gushing fountain, that never ceases or tires, but day and night pours out its wealth of pure water for man and beast!

Borings in this county have not reached the stratified rock, nor have they disclosed any new feature of the Drift mass into which they have been projected. As is nearly always the case elsewhere, the waters from these bores are often more or less impregnated with the salts of iron and are called "sulphur" waters and "magnetic" waters. No doubt the iron renders them valuable as a tonic in certain cases. Many beautiful springs rise in the county and some of these, too, are sufficiently charged with iron salts to color with brown or reddish oxide whatever the water flows over. No doubt this feature is due to its rising through ferruginous sand or other iron-bearing deposits.

MAXINKUCKEE.

W. H. THOMPSON AND S. E. LEE.

In many respects this is the most beautiful of the multitude of small lakes with which Northern and North-eastern Indiana are studded. Its shores are high, beautifully rounded, and clothed with the native forest. The waters are clean and cold. Hundreds of springs flow out from the banks, and many more rise from the bottom of the lake. Very few weeds grow in the water, and there is far less of moss and peaty formation than is common to our Indiana lakes. Here, to a large extent, sand gives place to gravel, and the beach is firm and clean. Though it is one of the deepest of our small lakes, it scarcely merits the name of "bottomless," given it by many of the people who reside on its shores and allow their imagination to fill the blue depths with wonders.

We were gravely told by one that every attempt to find bottom was a failure; by another that he *knew* that the water was more than three hundred feet deep, and by another that he had seen one hundred and eighty feet of line let down only one hundred yards off shore and no bottom was found. When we informed them that we did not expect to find any water one hundred feet deep they smiled contemptuously.

The result of our soundings gave seventy-six feet as the maximum depth. This was found at a point almost in the center of the lake, being very slightly to the west of the middle on an east and west line drawn through Rochester Point and a little to the north of that line. There is, however, a large area of this deep water, perhaps a thousand acres, which will average a depth of fifty feet.

The bottom of the lake is a very compact bowlder clay, covered in places with gravel, at others with sand, and at a few places, notably along the north-west shore, with heavy black muck. In many places a deposit of marl was found. A cross section taken by a line of soundings from Rochester Point on the west shore, in a direction about thirty degrees north of east, to West Point on the east shore, gave the following depths: 6 feet, 7 feet, 34 feet, 72 feet, 68 feet, 66 feet, 76 feet, 62 feet, 60 feet, 41 feet, 31 feet, 17 feet.

These soundings were taken at intervals of about one hundred and twenty yards.

The lake abounds in excellent fish. The big-mouthed black bass (*Micropteros salmoides*) was at one time very plentiful, but has either been too largely fished out or has become so wary that only the skilled and patient fisherman can succeed in sticking him with his hook.

The perch are very abundant, and fine strings of croppies are taken early in the spring.

The fish are now being protected from the seine, the net and spear, and it is hoped that the lake may again become as noted for fine fish as it was a dozen years ago.

The construction of the Vandalia Railroad's northern branch to South Bend, with a station at the village of Marmount, at the north-west shore of the lake, so facilitated access that the beautiful groves along the east side began to be dotted with cottages; hotels were established, club houses were erected, steamers began to puff about the new landings, and a fleet of little white sail-boats blew over the water. The cottagers have shown most excellent taste in that they have preserved the natural beauty of the groves and green banks, while building large and costly summer houses and the careful ornamentation of lawns and groves has handsomely supplemented without destroying the natural beauties of the place.

The springs which feed Maxinkuckee are very abundant, not only from the shores, but they may be seen in the clear water at a depth of ten feet gushing up from the bottom, and from the deepest parts of the lake rise columns of cold water, chilling the bather like an ice bath. These springs suggested the probability of obtaining successful flowing wells, and now so many have been found that along the east shore one can scarcely get beyond the sound of the spouting waters. The water from these wells is very clear and cold, and more or less ferruginous, a few of the wells being so highly impregnated with iron as to render the water slightly un-

pleasant to the taste until one gets used to it. Most of the water, however, is excellent at the first taste, and all of it is perfectly wholesome in use. Indeed, one of the causes of the prevailing good health of the cottagers, as well as the residents on the shores of Maxinkuckee, is found in the purity of the waters of the flowing wells and abounding springs. The borings made to obtain these wells have not been watched with sufficient care, nor have the meager notes made at the time been sufficiently preserved to enable us to obtain accurate information as to the true depth and character of the *strata* at each. Enough can be known, however, to prove that at least two, and probably three, *strata* of water-bearing sand and gravel will be passed through in a bore of two hundred feet, and each of which will lift its water to hights of from six to twenty feet above the level of the lake surface.

The wells now flowing, and which were visited and examined, were seen in the following order, beginning on the north-west shore of the lake near the Vandalia depot and going east:

First, at the Plymouth Club House, and the surrounding cottages of the members of the club, there are four wells. The well in front of the Club House runs a ram which supplies the house with water. This, like the other three wells, is bored about eight feet above the surface of the lake, and will flow to an additional hight of eight feet when confined.

The members having wells near their cottages are Messrs. H. G. Phayer, McDonald and Hill. Mr. Phayer utilizes the energy of his well in working a ram, while the much stronger flow at that of Mr. McDonald, wastes its force in a beautiful fountain. This flow, when unconfined, rises in a two-inch stream ten inches above the top of the pipe, which is itself eleven feet above the surface of the lake.

These four wells are all bored to about fifty feet, and each passes through the same strata of clay, sand and gravel. The bank of the lake upon which the Plymouth Club House stands is about forty feet high, and at the foot of this bank are a great number of springs. Mr. McDonald informed us that he had counted twenty-four within a few yards.

East of the Plymouth House is the Palmer House, a fine new hotel, with an excellent well forty-five feet deep, the top of the pipe being fifteen feet above the surface of the lake. The stream is one of two inches, and when confined to three-quarters of an inch, will rise to a hight of fourteen feet above the pipe. When this well was bored the water spouted twenty-seven feet high, flowing much blue clay and sand and often choking up. The first stratum of sand was struck in this well at a depth of twenty feet, the bore showing yellow clay to that depth. Below the sand a stratum of blue clay about fifteen feet thick was passed through, and the bore ended, at a depth of forty-five feet, in sand.

On the north-east shore, Mr. A. H. Culver has two wells, each seventy-two feet deep, bored at points eighteen feet above the surface of the lake.

The bores show the following strata:

Soil and yellow clay	8 ft.
Sand	14 ft.
Blue clay	38 ft.
Sand and gravel	12 ft.
Total	72 ft.

These wells will flow to a hight of thirty-one feet above the surface of the lake.

Mr. Stechorn, near Mr. Culver, has a well fifty feet deep, which has a small flow.

Farther east, Mr. Willis H. Vajen has a good well which flows nineteen feet above the surface of the lake. This bore showed forty feet of continuous clay, followed by ten feet of sand.

Near Mr. Vajen's place, on the east, the Peru Club has its Club House, and here the club has bored to a depth of one hundred and sixty feet, ending in obdurate hardpan. The flow of water from some higher stratum of sand is weak, being about an eighth of an inch from a two-inch pipe. No section could be obtained.

Farther east, "Bay View," the Indianapolis Club House, has a good well only twenty-eight feet deep.

The next well is on the lot of Mr. George W. Miller, of Peru, who has built no cottage, but with his family passes the summers in a large tent. His well is fifty feet deep, and was driven by two men in three hours. The per cent. of iron in the water from this well is evidently much less than in most others near it.

At Highland House, the property of Mrs. Judge Hiller, the well is thirty-three feet deep, though the flow of water was as strong when the first sand was reached at a depth of thirteen feet.

The first well driven at this place to a depth of only thirteen feet obtained so strong a flow that the water could not be confined. The enormous pressure burst through all restraint, and rose in a column six or seven inches thick. This at once stopped the wells which turned Mr. Morman's ram a hundred feet away. The well was finally plugged up, when Mr. Morman's wells again began to flow.

D. W. Morman, Esq., of Indianapolis, has four wells averaging about twenty-two feet deep, flowing about fifteen barrels per minute, which feed a ram supplying his grounds with excellent water. These wells were driven two years ago. In July, 1886, he bored a larger well at a point eight feet above the surface of the lake. At a depth of ninety-eight feet the bore stopped in blue clay. The section showed eleven feet of yellow clay, twenty-five feet of sand, and sixty-two feet of blue clay. A wonderful flow of water comes from this stratum of sand. The water will

rise to a level of twenty-two feet above the surface of the lake, and when we were there the water was leaping in a fountain seven feet above the top of the inch and a quarter pipe.

South of Mormon's place J. B. Dill has a good flow, reached at a depth of twenty feet.

The well bored by Hon. J. H. Vajen, at his beautiful place next south of Mr. Dill, was begun at a point eleven feet above the surface of the lake, and showed the following strata:

Soil and clay	6 ft.
Sand	3 ft.
Blue clay	23 ft.
Total	32 ft.

Mr. Vajen dug a well several years ago, which, on reaching a depth of eight feet, began to flow a milk-white water of about the consistency of cream, and which deposited a silicious, lime-like marl, and whitened the water of the lake for a distance of thirty feet from the water's edge. In the back part of Mr. Vajen's lot was a low. wet spot, which began to sink when the well began to flow, and continued to sink until the white flow changed to clear, pure water. Mr. Vajen has utilized the pressure of water from his well, the stream running a ram which supplies his premises with water, and also furnishes the power which revolves the beautiful colored light at the landing pier before his gate.

High upon the hill beside the Plymouth road, about one hundred yards from the lake, and fully thirty feet above it, gushes out the "Original Spring," as it is known, which pointed the index finger toward the first flowing well. This spring pours out a four-inch stream, and the boring of wells has never diminished the flow.